

NON-PUBLIC?: N  
ACCESSION #: 9109190255  
LICENSEE EVENT REPORT (LER)

FACILITY NAME: PRAIRIE ISLAND NUCLEAR GENERATING PLANT PAGE: 1  
OF 04  
UNIT 1

DOCKET NUMBER: 05000282

TITLE: Unit 1 Trip As A Result Of Rod Control System Failure  
EVENT DATE: 08/16/91 LER #: 91-011-00 REPORT DATE: 09/16/91

OTHER FACILITIES INVOLVED: Prairie Island Unit 2 DOCKET NO: 05000306

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR  
SECTION:  
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:  
NAME: Arne A Hunstad, Staff Engineer TELEPHONE: (612) 388-1121

COMPONENT FAILURE DESCRIPTION:  
CAUSE: X SYSTEM: AA COMPONENT: MANUFACTURER: W120  
REPORTABLE NPRDS: Yes

SUPPLEMENTAL REPORT EXPECTED: No

#### ABSTRACT:

At 0127 hours on August 16, 1991 Unit 1 tripped unexpectedly from 100% power. The "first out" annunciator was the negative flux rate trip. Review of rod position indication just prior to and after the trip indicated that the four Control Bank A, Group 2 rods that are powered from power cabinet 2AC began to fall into the core prior to receipt of the reactor trip signal. Extensive testing of the rod control system was done. Testing of the failure detection circuitry (urgent failure alarm) showed some conditions exist under which some rods would unexpectedly drop. The system does not provide protection against dropping rods for all component malfunctions or failures.

The most likely cause of the event was intermittent failure in a firing card for the stationary grippers supplied by power cabinet 2AC, causing interruption of power to the Control Bank A, Group 2 rods. During post

trip testing which simulated high temperatures found on firing components during normal operation, the card developed an unacceptable wave form in an oscillator circuit. This card had previously tested satisfactorily at room temperature. The intermittent control circuit failure occurred such that the failure detection circuitry did not protect the affected rods against dropping.

END OF ABSTRACT

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#### EVENT DESCRIPTION

On August 16, 1991 Unit 1 was at 100% power. At 0127 hours, the reactor tripped unexpectedly. The "first out" annunciator was the negative flux rate trip. All plant systems and components responded to the reactor trip as designed and the plant was stabilized in accordance with plant procedures. Investigation into the cause was begun immediately.

Inspection of the rod control system (EHS System Identifier AA) showed that the stationary gripper phase failure detection indicator lamp in power cabinet 2AC was lit; this indication led to further troubleshooting within power cabinet 2AC. Two blown fuse indicators appeared to indicate blown fuses, but no fuses were found blown. Review of rod position indication just prior to and after the trip indicated that the four Control Bank A, Group 2, rods that are powered from power cabinet 2AC began to fall into the core prior to receipt of the reactor trip signal.

Root cause investigation efforts were concentrated on power cabinet 2AC. The failure could not be made to recur. The rod control system operated normally with no sign of a malfunction, so all circuit boards that could affect Control Bank A were then tested. Several circuit boards were slightly outside of manufacturer's specifications. In accordance with vendor-recommended troubleshooting, all thyristors, inductors, resistors and capacitors in Control Bank A circuitry were checked and found to be in good condition.

After a Safety Evaluation was performed, a test was conducted to observe the rod control system operation under normal plant conditions. Control Bank A rods were slightly withdrawn. Thereafter, the rods were inserted and withdrawn between the 25-step and the 15-step position every half hour for several hours. No malfunctions occurred.

Since no definite failure could be found that would have caused the rods to drop, all three circuit boards that failed their testing, and four others that had passed their testing, were replaced with spares. These

four were selected because an intermittent failure could have contributed to the trip.

A control rod mechanism timing test was performed satisfactorily.

Further testing of the rod control system was done to determine if the failure detection circuitry (urgent failure alarm) was functioning as expected. This circuit is intended to apply "hold" power to the stationary and movable grippers of control rods in order to prevent those rods from dropping or from moving if certain control circuit failures occur. The test results showed some conditions exist under which some rods would unexpectedly drop. The system does not provide protection against dropping rods for all component malfunctions or failures.

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The following paragraph describes events which occurred during trip recovery and had nothing to do with the cause of the unit trip.

While in the process of returning the unit to service, an urgent failure alarm was received from the rod control system. The rods did not drop. The alarm was caused by problems with Control Bank C circuitry in power cabinet 2AC. The problem was found to be a shorted transistor on the movable gripper firing circuit card; this card had been installed the day before and had tested satisfactorily before installation. This problem could be made to recur. After the bad card was replaced, the unit was returned to service at 0500 on August 20, 1991.

#### CAUSE OF THE EVENT

The most likely cause of the event was intermittent failure in a firing card for the stationary grippers supplied by power cabinet 2AC causing interruption of power to Control Bank A, Group 2 rods. During testing, the card developed an unacceptable wave form in an oscillator circuit when subjected to heat, simulating temperatures found on card components during operation. This card had previously tested satisfactorily at room temperature. The intermittent control circuit failure occurred such that the failure detection circuitry did not protect the affected rods against dropping.

#### ANALYSIS OF THE EVENT

This event is reportable pursuant to 10CFR50.73(a)(2)(iv) since it involved an unplanned actuation of the reactor protection system. The event had no effect on public health and safety. The reactor protection system responded as designed to the negative flux rate caused by the

dropped rods and the plant was stabilized in the hot shutdown condition in accordance with plant procedures following the reactor trip.

#### CORRECTIVE ACTION

Corrective actions taken in order to return Unit 1 to service are detailed in Event Description above.

Further corrective actions will be taken. These are:

1. Perform additional failure analysis testing of the circuit cards removed from the rod control system.
2. Provide forced ventilation to the rod control system power cabinet cards.
3. Evaluate modifications to the rod control system circuitry to improve reliability.

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4. Add on-line monitoring of the rod control system for better diagnostics, with consideration of the potential to trend and predict problems.
5. Replace all firing cards and consider replacement of other circuit cards.

#### FAILED COMPONENT IDENTIFICATION

Westinghouse Full Length Rod Control System

#### PREVIOUS SIMILAR EVENTS

Previous similar events are described in Unit 2 LER's 89-004 and 90-012.

ATTACHMENT 1 TO 9109190255 PAGE 1 OF 1

NSP Northern States Power Company

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Minneapolis, Minnesota 55401-1927  
Telephone (612) 330-5500

September 16, 1991 10 CFR Part 50

Section 50.73

U S Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, DC 20555

PRAIRIE ISLAND NUCLEAR GENERATING PLANT  
Docket Nos. 50-282 License Nos. DPR-42  
50-306 DPR-60

Unit 1 Trip As a Result of Rod Control System Failure

The Licensee Event Report for this occurrence is attached.

This event was reported via the Emergency Notification System in accordance with 10 CFR Part 50, Section 50.72, on August 16, 1991. Please contact us if you require additional information related to this event.

Thomas M Parker  
Manager  
Nuclear Support Services

c: Regional Administrator - Region III, NRC  
NRR Project Manager, NRC  
Senior Resident Inspector, NRC  
MPCA  
Attn: Dr J W Ferman

Attachment

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